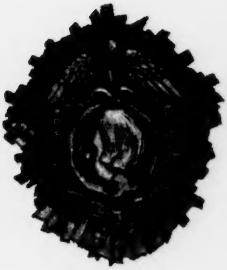
# Journal of Dentistry for Children



FOURTH QUARTER 1946

# Journal of Dentistry for Children

PUBLISHED BY THE AMERICAN SOCIETY
OF DENTISTRY FOR CHILDREN

ALFRED E. SEYLER, *Editor*
14615 E. Jefferson Avenue
Detroit 15, Michigan



**EDITORIAL BOARD**

James N. Gasaway — Stanley C. Brown — C. Ray Taylor

**CONTRIBUTING EDITORS**

John C. Brauer — Charles A. Sweet — Frank L. Lamons
Ralph L. Ireland — Harry Strusser — Walter C. McBride



Issued quarterly, in January, April, July and October. Subscription price, $1.50 per volume (four issues) to members of the American Society of Dentistry for Children, and libraries. $2.00 per year to others. Changes of address should be mailed to the Secretary, Ralph M. Erwin, 613 Corbett Bldg., Portland 4, Oregon.



Publication in the Journal of Dentistry for Children is not to be taken as an endorsement by the Publishers, the Editors or the Editorial Board.



Vol. XIII — FOURTH QUARTER — 1946


## CONTENTS


Secretary's Message ..... 89

Mouth Breathing as a Primary Etiologic Factor in the Production of Malocclusion
Joseph T. Hartsook, D.D.S. ..... 91

A Point of View toward Orthodontic Treatment
Charles M. Waldo, D.D.S. ..... 95

Vitamin K—Its Relation to Dental Conditions
Sumner K. Russman, D.D.S. ..... 99

Summary of Membership ..... 104

Editorial ..... 105

Around the Country
Conducted by Stan Brown ..... 107

Teething and Its Significance
Henry J. Kruska, D.D.S. ..... 110

Tooth Brushing: Its Effect on Gingival Tissues
Joseph Cabot, D.D.S. ..... 113

Our Rightful Heritage
James Robinson ..... 117

The Physical and Chemical Properties of Silver Amalgam
Ray A. Jacobson, D.D.S. ..... 118

# Secretary's Message

Since the printing of the third quarter issue of our Journal the A.S.D.C. has had a change in the office of President. Dr. Ralph L. Ireland served this society faithfully and competently for three years as Secretary, one year as President-elect, and ascended to the Presidency at Houston in October 1941. He, as all his fellow officers, served willingly through the extended war years and expected an opportunity to hold a full scale meeting on the usual occasion of the A.D.A. meeting which was expected to be held this year. When it became evident that the A.D.A. was not to have a meeting and that the A.S.D.C. could not feasibly hold a meeting at which time new officers could be selected, Dr. Ireland expressed the belief that in the interest of the Society a new President should assume the office, installing new ideas and administration leading up to the next full scale A.S.D.C. meeting. For these and other reasons expressed in his communication to the members of the Executive Council his resignation was accepted.

As provided in the Constitution and By-Laws, President-elect Dr. Jack Wisan ascended to the Presidency, early in August. The Society shall always be indebted to Dr. Ireland for innumerable hours of work and administration so faithfully and capably given through his regular years of service and especially through the extra years as incurred through the necessary extension of his Presidency.

In assuming the office of President Dr. Wisan will make an exceptionally fine leader for the A.S.D.C. With his personal professional activities in the field of public health work he will be able to lead and direct the policies of the Society to the additional betterment of the organization as events of public health activities and private practice policies may indicate. Dr. Wisan has expressed an eagerness to serve capably and we who personally know him, know that this eagerness will be exceeded only by his achievements as President. As Secretary, I wish to ask especially of the various State Unit officers that they extend to Dr. Wisan every possible assistance of Unit activity and support.

In-as-much as this will be the last issue of 1946 I wish to present a membership summary as of October 1, 1946. It is gratifying to see that the number of members in the armed forces has been reduced to only eleven to our knowledge and it is logical to expect that these members are now returned to the joys of private practice. It is equally surprising that we have a grand total of 887 members, 784 of whom are in the United States. To me these figures are significant of two factors. First the State Units and their officers have done a wonderful job of holding their memberships through the trying war years and also in securing new members. Second, that an interest in dentistry for children is increasing within the ranks of the individual dental practitioners, and a feeling that affiliation with this Society and receiving the Journal of Dentistry for Children will assist them in their professional services to the children of their practices.

The 58 drops represent requested inactivation of membership and others who were dropped because of dues delinquency. In addition to these there were 37 who were dropped as members in the armed forces who have become lost because of inaccuracies of addresses incurred through military transfers.

*Dr. R. M. Erwin Jr.*

# DECIDUOUS DENTOFORMS

## IVORINE—With Fixed Teeth

700—Set of upper and lower ..... $ 5.00
763-4—Set of upper and lower, with 6-year molars ..... 5.00
701—Set of upper and lower, used for constructing space retainers ..... 5.00

**NOTE:** The above models are in one color, all-ivory, i.e. ivory teeth and ivory jaws.

Any of the above sets of models can be supplied articulated. For the articulated models add $2.00 to the prices listed.

## IVORINE—With Removable Teeth

760—Set of upper and lower pink jaws, with 24 removable Ivorine teeth including six-year molars, and spring-joint articulator ..... $25.00
761—Upper of No. 760 ..... 12.50
762—Lower of No. 760 ..... 12.50
Extra individual teeth, each ..... .50

## RUBBER—With Removable Ivorine Teeth

R760—Set of upper and lower rubber jaws, with 24 removable Ivorine teeth ..... $22.00
R761—Upper rubber jaw with 12 removable Ivorine teeth ..... 12.00
R762—Lower rubber jaw with 12 removable Ivorine teeth ..... 12.00

## PLASTER Teeth and Jaws

280—3 diameters: Set of 20 deciduous teeth with natural-shaped roots ..... $ 7.00 per set of 20 teeth
Individually ..... .50 each for molars; .35 each for all others
281—3 diameters: Upper and lower full-jaws with fixed teeth removable, including 6-year molars ..... 14.00 per set
Extra individual teeth ..... .35 each
F281—3 diameters: Upper and lower full-jaws with fixed teeth, including 6-year molars ..... 6.00 per set
282—6 diameters: Upper and lower half-jaws with 10 removable teeth ..... 8.00
Extra individual teeth ..... .50 each for molars; .35 each for all others

*"The House of a Thousand Models"*

## Columbia Dentoform Corporation

131 EAST 23rd STREET NEW YORK 10, N. Y.

# Mouth Breathing as a Primary Etiologic Factor in the Production of Malocclusion

By JOSEPH T. HARTSOOK, A.B., D.D.S.

*Editor's Note:*

*An active member of our Michigan Unit, Joe is presenting his second paper to the readers of our Journal. I sometimes wonder where he finds the time to engage in his many activities which range from assistant to Ken Easlick at Ann Arbor to presentations before the Detroit District Dental Society, interspersed with his private practice of Pedodontics at Ann Arbor!!*

*In this article I seem to see the "get at the facts" attitude of gentle Joe—and I suggest you read it to completion.*

*A.E.S.*

When one critically reviews the literature on habits and occlusion, he soon reaches a point where he questions the influence of mouth breathing on the development of malocclusion.

In this paper it is planned to review the literature and present some of the conclusions which have been submitted to explain the manner in which mouth breathing, with or without definite nasal obstruction, may affect the growth and development of the arches and the occlusion of the teeth. An attempt will be made to present a scientific conclusion regarding the influence of the habit on occlusion, based solely on well-conducted studies and observations.

Johnson[1] states that mouth breathing is a common habit but all patients who hold the mouth open are not mouth breathers. Many breathe entirely through the mouth. Some hold the mouth open and breathe through both the mouth and the nose. Others hold the mouth open but breathe through the nose.

From Sillman[2] one learns that mouth breathing is often the result of obstruction due to a deviated nasal septum, edema of the nasal mucous membrane, or hypertrophied lymphoid tissue in the naso-pharynx. Cooke[3] says, "Up to the age of six obstruction is frequently due to adenoid and tonsillar hypertrophy usually associated but occasionally existing separately. Whether adenoid hypertrophy is due to heredity, nutritional defects or infection is not known; but certain it is that infection if not primary, soon is established, with resulting infection of the nasal and sinus membranes. The absence of proper nasal function leads to arrested facial development which causes septal deflection, a narrow high-arched palate and an over-development of the anterior portion of the maxillae."

Brash[4] considers mere speculations the conclusions that adenoids and mouth breathing interfere directly or indirectly with the growth of the jaws and are, therefore, very frequently responsible for the malocclusion associated with a contracted palate and V-shaped arch. Lack of evidence has permitted writers to indulge in these speculations before a correlation has been established between nasal obstruction and the form of the jaws.

Johnson,[5] in an article published in 1942 says, "The classical type of malocclusion often found among mouth breathers is associated with a narrowing of the maxillary arch and possibly of the mandibular arch, protrusion of the maxillary incisors, supraversion of the mandibular incisors, a lack of vertical development in the bicuspid and molar areas and distal relationships of the mandible to the maxilla. With this type of malocclusion, there is a short, under-developed upper lip, a lower lip that is thickened and rolled outward, under-developed nostrils, lack of tone of the facial musculature and often a vacant stare.

McCoy[6] writes that an habitual mouth breather of long standing has a characteristic appearance and is usually possessed of a distinctive type of dental and oral mal-develop-

ment. In consideration of the mechanics involved when mouth breathing is practiced, he says, "Muscles that depress the mandible are attached on the inner side of the horizontal ramus, and with each inspiration the muscular pull upon the mandible is backward which in time may influence the bone to modify and bring the lower teeth distal to normal. After the muscles have established the molars in this distal relation, all the lower teeth that are erupted at a later period must assume a similar distal malrelation, and the mechanics of this malocclusion is constantly operating to mould and alter the bones in accordance with its needs. The tongue is not held in the roof of the mouth and consequently the upper teeth are deprived of their muscular support. This establishes an unbalanced relationship between the external and internal muscular forces about the mouth, and favors the development of a narrow upper dental arch. The lips are not drawn against the teeth, and the upper lip is so little used that it exerts but slight influence on the upper anterior teeth, while the lower lip, instead of binding over the lower edge of the upper incisors, turns outward, and on account of the malrelation of the two arches the lower lip rests between them and becomes a factor in pushing the upper anterior teeth forward. The bones of the face are, therefore, subjected to the perverted mechanical action of mal-locked teeth, to perverted muscular action due to altered functions of the mouth and nose and to the altered mechanics of having the air pass through the mouth instead of the nose."

Hemley[7] agrees with McCoy that the backward muscular pull on the mandible causes it to assume a distal relationship with the maxilla.

In contrast to their opinions, Brash[8] states that the idea that pressure is exerted in an abnormal direction when the mouth is habitually kept open, and that this pressure may not merely affect the position of the teeth but may mechanically mold the form of the jaws as they grow, generally has been accepted as the chief explanation of the supposed definite relation between mouth breathing and narrow jaws. He writes further that this opinion even has been given the authority which belongs to the result of controlled experiment and has been quoted by some as evidence of the automatic control of bone form by muscular action.

It is apparent from a review of the literature that some of the theories about the manner in which mouth breathing may affect the growth and development of the jaws do not warrant serious consideration. The mechanical forcing of the maxilla (apart from its normal growth and development) and the forcing of the palate upward, accompanied with deflection of the nasal septum by the compressing action of the cheeks presents a difficult opinion to accept without accompanying scientific proof. Equally valueless is the opinion that a stream of air entering the mouth rather than the nose would in time force the palate upwards.

Another plausible explanation of the influence of pressure on the molding of the bones of the jaws suggests that the habitual opening of the mouth produces an abnormal pressure on the teeth and the sides of the jaws, possibly by a dragging action of the cheeks and lips by the depressed mandible, or, by the direct action of the muscles themselves. This muscular action plus the absence of the counteracting tongue pressure when the mouth is open is assumed to act upon the upper jaw. It is quite possible that the lateral muscular pressure could exert a definite influence upon the growth of the jaws if it were of sufficient strength. Without factual knowledge, the question arises whether or not mouth breathing can produce a force of external, lateral pressure sufficient to exercise such a mechanical control on the growth of the arches.

Another theory proposes that habitual mouth breathing may interfere so seriously with the proper performance of mastication that the functional stimulus for the growth of the jaws may be reduced below the minimum required for normal growth and development. Strang[9] suggests that the distal relationship of the mandible to the maxilla is due to an undergrowth of the mandible due, primarily, to a disturbance of its growth pattern either prenatally or during the first or second year of life. He concludes that once this distal relationship of the mandible is

established, there is a tendency for the deformity to become progressively worse as a result of the action of the perverted functional forces that are now brought into action. He says, "The depressing of the mandible associated with mouth breathing automatically throws this bone into a more exaggerated distal relationship to the cranium and also keeps the occlusal surfaces of the teeth apart and so deprives the mandible and maxilla of the stimulating influence of functional stress. This retards their inherent growth tendencies." Here again, as with the mechanical pressure theory, lack of evidence leads one to conclude that such an opinion hardly can be justified. It is obvious that there is considerable information yet to be acquired concerning genetics, endocrine gland functions and other factors that may be associated with the control of bone growth, before one scientifically can correlate mouth breathing with deformities of the jaws and malocclusion of the teeth.

The blocking of the naso-pharynx by adenoids with the diminution or cessation of nasal breathing has been presented as a mechanism to explain the alternation of normal growth and development of the jaws. The assumption is that the absence of nasal breathing may indirectly affect the form of the maxillary arch through interference with the growth of the upper facial skeleton as a whole and with the floor of the nasal cavities in particular.

Brash[10] states that evidence obtained by McKenzie through the examination of 222 cases of adenoids at the Central London Throat and Ear Hospital has produced a change of attitude towards the conclusion that mouth breathing is a primary etiologic factor in the production of deformities of the dental arches. McKenzie's chief concern was to obtain evidence for or against the idea that artificial feeding may affect the form of the palate. However, incidental to his real purpose for conducting the study, he found that over 40 per cent of the children with adenoids had normal palates, and that deformed palates occurred in children who never had adenoids. From the evidence, based upon such a carefully conducted study, one has reason to question that mouth breathing, due to nasal obstruction, is a primary cause of deformities of the maxilla and consequently of malocclusion of the teeth.

A study of 800 operated adenoid patients by Whitaker[11] verified this conclusion.

The British Society for the Study of Orthodontics[12] made a study of the etiology of contracted dental arches. The Society concluded that mouth breathing is not followed necessarily by a contracted arch. Of the 25 patients studied, only one patient was found who corresponded with the classical, or text-book description of a mouth breather's palate. Only two other patients were found to have a pronounced contraction of the maxilla.

Sillman[13] in a study, reported in 1942, expresses the opinion that mouth breathing does not appear to be a primary cause of malocclusion of the teeth and this opinion seems to be representative of the trend of thought today when it is based upon scientific, factual data.

Huber and Reynolds[14] in a dentofacial study of 500 male university students found 27 mouth breathers (5.4 per cent). The dental occlusions of this group of mouth breathers distributed as follows: one anatomically correct; 16, Class I; 8 Class II, and 2, Class III patients. From these data, it was concluded that mouth breathing is not limited to one particular type of occlusion, but is rather well distributed among all dentitions.

Howard,[15] being dissatisfied with the tendency to accept teachings which have no background of scientific proof, made a survey of 500 tonsil patients at the Good Samaritan Clinic, at Atlanta, Georgia, an institution primarily interested in endocrine research. In this group of 500 tonsil patients a number showed a definite history of previous operation for adenoids and tonsils, a number were designated as definite mouth breathers and still another group presented deviated septa. Of the 159 definite mouth breathers in this group, only twenty-two, or 13.9 per cent, presented Class II Division I malocclusions, the type commonly associated with mouth breathing. Ninety-four, or 59.1 per cent presented normal jaws, normal arches and normal occlusion. The remaining 43 of the 159 pa-

tients, or 27.1 per cent, were divided between Class I malocclusion, local in origin, Class I, with a growth deficiency of the arches, and Class III malocclusion. The findings from this scientifically conducted study present statistical evidence that mouth breathing is not a primary factor in the production of malocclusion of the teeth.

Two conclusions may be presented as the result of this survey. It is evident, from the data of the scientific studies that have been presented, that mouth breathing is not a primary etiologic factor in the production of malocclusion, and, that the occlusions of mouth breathers are distributed among all types of occlusions, rather than being limited to one particular or classic type of malocclusion.

Secondly, it must be concluded, that for the welfare and progress of the dental profession, one should base his teachings on conclusions which can be substantiated with proof that is the result of scientifically conducted studies.

**BIBLIOGRAPHY**


1. Johnson, L. R. Habits and their relation to malocclusion. Am. Dent. A. J., 30:848-52, June 1, 1943.
2. Sillman, J. H. Malocclusion in the deciduous dentition: serial study from birth to five years. Am. J. Orthodont. and Oral Surg. (Orthodont. Sect.), 28: 197-209, Apr. 1942.
3. Cooke, R. A. The role of allergy in medico-dental problems. p. 134-40. (In Anderson, G. M., ed. Proceedings of the Dental Centenary Celebration. Baltimore, Waverly Press, 1940. VII/1061 p.)
4. Brash, J. C. The aetiology or irregularity and malocclusion of the teeth. (London), Dental Board of the United Kingdom, (1929). XI/274 p. (p. 212-22).
5. Johnson, op. cit. p. 851.
6. McCoy, J. D. Applied orthodontics. 5th ed., Philadelphia, Lea and Febiger, 1941. 530 p (p. 100-5).
7. Hemley, Samuel. Fundamentals of occlusion. Philadelphia, Saunders, 1944. VII/356 p. (p. 225-28).
8. Brash, op. cit. p. 213.
9. Strang, R. H. W. A textbook of orthodontia. 2nd ed., Philadelphia, Lee and Febiger, 1943. 724 p. (p. 141-45).
10. Brash, op. cit. p. 220.
11. Brash, op. cit. p. 220.
12. Brash, op. cit. p. 220.
13. Sillman, op. cit. p. 203.
14. Huber, R. E., and Reynolds, J. W. A dentofacial study of male students at the University of Michigan in the physical hardening program. Am. J. Orthodont. and Oral Surg. (Orthodont. Sect.), 32:1-21, Jan. 1946.
15. Howard, C. C. Inherent growth and its influence on malocclusion. Am. Dent. A. J., 19:642-8, Apr. 1932.


"There is a feeble effort on the part of many to overlook what the profession has failed to accomplish in the care of dental health for children. Is it not the responsibility of the dental profession to emphasize dentistry for children and really do something about it? The marvelous progress made by our profession only emphasizes the need for more and better children's dentistry until such time as better preventive and remedial measures are available. There is not sufficient manpower in dentistry to rehabilitate the millions of young patients through restorative methods alone. Preventive dentistry must be practiced, and research encouraged."

*Sterling V. Mead, President*
*American Dental Association:*
*J.A.D.A. 33:1433, Nov. 1 ,1946.*

# A Point of View Toward Orthodontic Treatment

CHARLES M. WALDO, A.B., M.S., D.D.S.
Harvard School of Dental Medicine

*Editor's Note:*

*Dr. Waldo, born at Canisteo, New York in 1906, received his D.D.S. from the University of Michigan School of Dentistry in 1930. While attending Graduate School, he was an instructor, and received his M.S. in Orthodontics in 1932. From 1932-38 he served the University of Colorado School of Medicine as a Fellow in Orthodontics, returning to Ann Arbor as Assistant Professor of Orthodontics for a three year period. At the present time Dr. Waldo is Assistant Professor of Orthodontics at Harvard.*

*I'm sure that many of our orthodontist friends will find points of agreement as well as controversy in this well written article.* *A.E.S.*

It is my purpose to discuss the question—"What should orthodontic treatment seek to accomplish?" I am convinced that the answer to this question is by far the most important factor in determining how a man conducts his practice and how well he serves his patients. It is so important, in fact, that anyone who undertakes the treatment of orthodontic cases should invest the time, thought, observation, and critical reading essential to arriving at his own decisions in the matter. This, I believe, is seldom done. The newcomer to orthodontics is too often persuaded by the proponents of various systems of treatment to skip this part of his education and accept a point of view ready-made with all the tenets and ramifications, neatly tied up. All of us are familiar with these. One holds that treatment should produce perfection, should seek to give each patient an ideal occlusion. Another demands that treatment satisfy the dictates of a formula based upon arbitrary "laws"; another, that treatment produce a certain set of facial proportions and mechanical relationships that its author has decided are best. There are others. The more dogmatic they are the more satisfying they are—and the less in touch with reality. Attempts to modify and liberalize them as, for example, orthodontic treatment should seek to give the patient an average denture, fail because they are difficult or impossible to put to practical use. All of them have one great fallacy in common—they ignore the wide range of harmless variation in human beings and attempt to define in a positive way what is right or "normal." Such definitions are useful in orthodontics in so far as they help us to classify and describe occlusal conditions and make orderly observations, but they are inadequate and misleading as criteria to determine treatment.

We need some more effective means of determining just what the patient's needs are; something, in fact, to replace the arbitrary criteria I have just been complaining about. The logical substitute and, indeed if we consider orthodontics a health service, the only possible consideration, is the health of the patient. If the patient is healthy or if his health is not threatened, he does not *need* treatment. If he is not healthy because of conditions that fall within our province, he *needs* enough treatment to return him to a state of health and no more. This point of view is not new or original with me. For years it has formed the basis of practice for a numerically small but significant, group of men who follow no "system" and, in fact, have little in common except a desire to serve their patients and a respect for biologic fact in so doing. There are reasons why this point of view has not been more widely accepted. It is no short cut to the easy solution of or-

thodontic problems. It requires us to consider much more than the teeth and facial proportions in evaluating the status of each patient as he comes to us, and if the patient is a growing child, it may require repeated observations before decisions can be reached. The usual definitions of health (the absence of disease) and of disease (a departure from health) are not very helpful to us.

At this point I should like to refer briefly to the work of the Child Research Council and to some of my experiences as a member of that group, since I believe these are pertinent to the discussion and helpful in indicating how health may be used as a criterion for orthodontic treatment.

As many of you may know, the Child Research Council, located at the University of Colorado School of Medicine, is a research group devoted to the study of growing children, following the same individuals in their progress from birth to maturity. Among other things, it seeks to determine which of the highly variable attributes of these children, physical, psychological, and sociological are consistent with health, and in so doing, to define what may be called the range of normal variation for each attribute. All of the children in the group are healthy. Whenever evidence turns up that a child is not healthy, he is removed from the group and replaced by another. When these children have reached maturity and it is possible to say that each has passed through a healthy infancy, childhood, and adolescence to maturity, the characteristics and attributes they have displayed must be considered consistent with health no matter how widely they differ from what the text-books say. It is obvious that in undertaking such a long range, expensive and painstaking study, a sound concept of what consitutes health is of the utmost importance. In arriving at a workable definition, it was recognized that the individual is always the product of the gene material passed on by his parents and the environment in which he lives. Underlying all of his efforts and accomplishments in life is the necessity of making a successful adjustment to his own particular environment. Health is taken to be synonomous with such an adjustment to environment and any conditions which physically or mentally handicap the individual in making it are considered as departures from health.

Most of the detailed findings of the Child Research Council will not be available until after a significant number of the children have reached maturity, but throughout the course of the study certain general findings have become so emphatically evident (as they have in other similar studies) that they are worthy of mention. Those of greatest importance to us are (1) that individuals differ in almost every attribute and characteristic studied, that the range of variation is often wide and, what is most important, that even wide variations may be entirely consistent with health; (2) that repeated examinations of the same individual, particularly if he is growing, aid greatly in determining how he differs from other individuals, what his inherent patterns, trends, and tendencies may be, and what should be considered "normal" for him; (3) that consideration of the whole individual organism is essential in determining either health or a departure from it.

My association with this study for several years gave me a chance to become well acquainted not only with the children and their dental conditions, but with the extensive records of their progress and performance in other categories and with the opinions of other observers. I was particularly concerned to find that a number of these healthy children had dentures which, even under a rather liberal use of current orthodontic standards, had to be classified as malocclusions. I am sure that most orthodontists would have recommended treatment for at least a part of these without hesitation, yet there was no evidence whatsoever that they were handicapped in any way by their dental conditions. Not all of these children were in the early age groups. One boy had an excellent record throughout the nineteen years of his life except for a malocclusion which could be described according to Angle's classification as a Class II, Division I of moderate severity. I had occasion to show his dental records, including yearly casts covering a period of eleven years, to a group of visiting orthodontists. All were interested in the malocclusion and its develop-

ment as shown by the casts, all discussed methods of treatment, but none suggested the possibility of leaving the case untreated. This account is not offered as a criticism of the orthodontists or as proof of anything. It does emphasize, however, the need for a broad enough concept of what is normal to allow for variations which do the patient no harm.

We can put this point of view to work in every day practice by starting from the premise that all conditions are normal unless we find evidence that they handicap the patient or threaten seriously to do so. I have found the following outline useful in deciding whether or not conditions of immediate concern to the orthodontist constitute handicaps to health in a given case:

A. Handicaps to physical well-being.
   1. Conditions which seriously interfere with the mastication of food or with speech.
   2. Conditions which endanger the health of the teeth themselves, their supporting structures, or adjacent soft tissues.
   3. Conditions in which the mechanical relations of the opposing teeth tend to restrict or pervert facial growth.

B. Handicaps to mental well-being.
   1. Conditions which seriously detract from the patient's appearance.
   2. Conditions which are a real source of worry, but do not seriously detract from his appearance.
   3. Conditions falling under "A" which are a real source of worry.

Where decisions are difficult, we will have to find out as much as we can about the patient; what sort of person he is, his trends and tendencies, what his parents and brothers and sisters are like, his particular requirements, what sort of environment he lives in and is likely to live in, what are his biological assets and liabilities. It should not be expected that this can always be done in one or two visits. In many cases repeated observations over a period of months or years will be necessary.

I should like to point out two pitfalls in this approach to treatment. One stems from the probability that early in the examination of a patient his occlusion has been classified (for example, according to Angle's classification). This is a useful procedure, if kept in its place. The danger is that once a case is classified as malocclusion, a decision that treatment is needed will be reached prematurely and all further consideration will be wasted. The other danger lies in the utilization of a number of assumptions which have been repeated so often that they have become axiomatic but which are not supported by evidence. For example, it has been widely assumed that any malocclusion, i.e., any significant departure from the concept of ideal occlusion, decreases chewing efficiency and therefor endangers the nutritional status of the patient. Even if his nutritional status appears to be good, it is assumed that it will be better if the malocclusion is treated. It has also been assumed that any malocclusion which is esthetically undesirable to the orthodontist is a detriment to the well-being of the patient.

How well do we need to chew our food? How efficient does a dental apparatus need to be to play its part in an adequate digestive system? So far as I know, there is little or no evidence but there are numerous indications that, under ordinary circumstances, it doesn't need to be very efficient. Much of the food we eat is ready to be swallowed without chewing; well nourished individuals are seen who have (a) very poor dental equipment or (b) very good dental equipment which they hardly use. I once thought I could get some information on this subject since a study of gastro-intestinal efficiency was undertaken, utilizing the children in the Child Research Council group. They were fed a standard meal containing barium and X-ray pictures were made at subsequent intervals to note its progress through the tract. It was my intention to divide the children into two groups, those with malocclusions and those without; feed them a meal that required chewing and compare results. The study was never started simply because the results of the original study showed such wide variation that no baseline could be established. It seems likely that individuals can be expected to differ in their needs for masticatory efficiency as they

do in other respects and that the requirements of the same individual may vary. A child poorly endowed by nature, with several strikes against him from the start, may need the advantage of extra chewing efficiency but this must be decided on the merits of the individual case.

Not all malocclusions which detract from the appearance of the patient constitute handicaps to the mental health. Combined with an assured, aggressive personality and a satisfactory adjustment to environment even a severe deformity may be well tolerated. On the other hand, the importance of a trivial irregularity should not be underestimated if it is a real source of worry to a timid, insecure person. Much could be said about the handling of these cases, but the point I want to make particularly is that decisions regarding them should rest on the requirements of the individual case and not on the preference of the orthodontist.

I have tried to indicate how a point of view based upon meeting the needs of the individual patient can be used as an approach to the problems of orthodontic treatment. I should like to conclude by pointing out some implications of this point of view from the standpoint of the patient. If it is followed conscientiously, it results in a minimum of treatment, helping us to (1) utilize our efforts in treating cases that really need it and, (2) confine our treatment of any case to that which seeks results of real value to the patient. Moreover, it removes the curse from limited treatment objectives designed to eliminate only the most distressing handicaps where a lack of financial or biological resources precludes a more thorough job. This has been bitterly decried as lowering the standards of the profession by the advocates of "all or none" treatment. They hold that only the best is good enough for their patients, that the best is perfection (i.e., what *they* conceive to be the ideal), and that it is not right to aim at something less because the patient can not pay. These are admirable sentiments, but no matter how sincerely they are held, the practical result is that many people are forced to go without who would be immeasurably benefitted by a short period of treatment. I have treated a number of such patients and seen six months' treatment take them out of the category of the handicapped and make them, not perfect, but about like the rest of us—which was what they wanted. No charity was asked or given. I was as well paid for my time as I would have been in any event, not counting the satisfaction which the patient and I received.

In closing, let me repeat that the course I have indicated is no short cut. It calls for thought, judgment, and a willingness to break with tradition but it is well worth the effort.

## NOTICE

**There is a splendid opportunity available to a capable young man, possessed of a California license, and desiring to specialize in Pedodontics in a well established practice near San Francisco. Any interested individual may communicate with the Editor, who will forward the communication.**

**A.E.S.**

# Vitamin K: Its Relationship to Dental Conditions

SUMNER K. RUSSMAN, D.D.S.

*Editor's Note:*

*Sumner Russman, when he obtains his M.S. in Pedodontics, toward which he is now working at Ann Arbor under Ken Easlick, et al, plans to return to his home in Weatherford, Oklahoma to specialize in Pedodontics. A graduate of St. Louis University in 1938, Russ served 5½ years in the Army, leaving as a Lt. Colonel, after service in several camps and the E.T.O. His pleasing personality is the result of his contact with the public as salesman during college vacation periods and because he is in the profession he desired to enter way back in his high school days. We've met Russ at several Detroit pedodontic gatherings—and hope to present more of his writings to you in the future.*

*A.E.S.*

During recent years several suggestions have been advanced for the control of dental caries, but the most recent one is the use of synthetic vitamin K to inhibit dental caries.

Vitamin K, discovered in Copenhagen through experiments by Dam with chicks, is necessary for blood clotting. It is a fat-soluble vitamin and occurs in various foods, especially in green vegetables. It also occurs in putrefaction bacteria. Little is known so far about its physical and chemical properties and no unit can be yet established except one of arbitrary and limited value. Clinically it is almost specific in the hemorrhage manifestations of biliary and hepatic diseases, but its indiscriminate use in hemorrhagic diseases of all types should be discouraged in spite of the lack of evidence of toxicity to date. Some of the diseases in which the administration of vitamin K has been an effective control are the correction of hemorrhage disease of the newborn, certain diarrheal diseases, such as ulcerative colitis, sprue, and celiac disease which may cause hypoprothrombinemia, and obstructive jaundice.[1]

Vitamin K is concerned with the production of prothrombin and a deficiency is followed by a decrease in the prothrombin of the blood. If the decrease in prothrombin is great enough, various clinical types of hemorrhagic disease appear. Vitamin K is not a factor in all types of hemorrhagic disease, but only in those in which the bleeding is related to a decreased prothrombin concentration. Furthermore, vitamin K is not the only factor concerned in the production of prothrombin; severe damage of the liver is one other factor, which at least, may cause low prothrombin levels and bleeding irrespective of the amount of available vitamin K.

The answering of the following questions seems required in order to decide the effectiveness of vitamin K:

1. Has sufficient evidence been submitted to indicate that the chewing of gum containing synthetic vitamin K will reduce the dental caries-attack rate?
2. Will the chewing of vitamin K products reduce the dental caries-attack rate?
3. Would the incorporation of this synthetic substance in a lozenge prove to be a better type of medication against caries?
4. Will fortification of the diet with vitamin K reduce gingival diseases?
5. Does the optimal ingestion of vitamin K promote gingival health?
6. Is the human organism apt to suffer a vitamin K shortage?
7. What interferes with the assimilation of vitamin K?

The only known experiment to indicate tooth decay can be reduced through the use of vitamin K has been conducted at the Northwestern University School of Dentistry and

the results have been published and publicized.

In 1942, Dr. Leonard S. Fosdick, a chemist at Northwestern University, and his associates reported that synthetic vitamin K retarded the formation of the acids that cause tooth decay. The synthetic vitamin K, he concluded, had the ability to retard the action of enzymes in the mouth and, therefore, in combination with the saliva, it slowed the rate of acid formation.

It appeared to Fosdick that the ideal method of administration would be by chewing gum, which could be chewed without inconvenience immediately after meals. Furthermore, he concluded that the chewing of the gum had the effect of driving the vitamin K into areas of the teeth most susceptible to decay.

An experiment, using students from the School of Dentistry, was undertaken and continued over a period of months to determine how effectively vitamin K in chewing gum would retard tooth decay. The procedures of the experiment follow:

1. For purposes of comparisons, the following groups were utilized:

a. VITAMIN K GUM—Records were made of subjects participating in the experiment who chewed gum without the added vitamin. Clinical and radiographic examinations were completed.

b. REGULAR GUM—Records were made of subjects participating in the experiment who chewed gum without the added vitamin. Again both clinical and radiographic examinations were completed.

c. EXTRA CONTROLS—Records of students in the same classes at the School as those who were participating in the experiment were used as extra controls.

d. PREVIOUS NORTHWESTERN UNIVERSITY STUDENT CONTROLS—Radiographic records were used of caries-progress among students in the School of Dentistry in preceding years.

e. COAST GUARD CADETS—The caries-experience of men at the U. S. Coast Guard Academy was used as reported by Armstrong, Dean, and Singleton. Clinical and radiographic examinations were included in the accumulation of this experience.

f. U. S. PUBLIC HEALTH SERVICE—The caries-experience of similar age groups was used as recorded by Klein. Only clinical examinations were made to secure this experience.

Due to a shortage of the gum base required for the chewing gum the formula had to be changed. This change was accomplished by the addition of calcium carbonate, which lent desirable characteristics to the available gum base. Calcium carbonate was incorporated in both the Vitamin K gum group and the regular gum group.

2. The results for the first 3 groups were compiled for a period of 1 year, and compared with the tabulations of the incidence of caries reported by other investigators for a similar period. The results were continued for a period of 18 months, to take advantage of the greater changes that would be expected to occur in the lower period. The results for the 18 month period on vitamin K were compared directly with the simultaneous control groups at Northwestern University and indirect comparisons were made with the results of other investigators whose figures were available for only 12 months or only 18 months. The data were altered through multiplication by factors of 2/3 or 3/2, depending on the length of the experiment to give a basis for comparison.

3. The subjects were required to use the gum immediately after each meal and to chew for 10 or more minutes.

4. No attempt was made to control the type or amount of food ingested.

The results of the experiment in terms of average new cavities per person are shown in the following table which also shows the comparison that was made with corresponding figures from other groups:

| | 1 YEAR | | 18 MONTHS | |
|---|---|---|---|---|
| | Radiograms | Clinics and Radiograms | Radiograms | Clinics and Radiograms |
| Vit. K Gum | 0.13 | 0.42 | 0.17 | 0.64 |
| Reg. Gum | 0.24 | 0.80 | 0.22 | 1.10 |
| Extra Control | 0.36 | 0.92 | 0.55 | 1.40 |
| Prev. Students | 1.20 | | 1.80 | |
| Coast Guard | | 2.20 | | 3.30 |
| Pub. Health | | 1.50 | | 2.25 |

"On the basis of radiographic examinations alone, at the 1 year period the vitamin K decreased the caries activity 46% as compared to the regular gum, 64% as compared to the extra control group where caries activity should be less than average, and 89% as compared to the extra control group where caries activity should be less than average, and 89% as compared to caries activity in the group of previous students. On this basis of comparison, the use of ordinary gum containing calcium carbonate filler decreased caries activity 33 to 80%.

"For comparison with the results of clinical and radiographic examinations of the U. S. Coast Guard group, the figures for the results obtained by clinical examination of the vitaman K gum, regular gum and extra control groups at the end of 18 months were reduced by one third. On this basis, the use of vitaman K gum for 12 months reduced caries incidence 48% as compared with the regular gum, 54% as compared with the extra control group, 89% as compared with the U. S. Coast Guard group and 72% as compared to Public Health figures. On the same basis, the use of the regular gum containing calcium carbonate reduced caries incidence 13 to 60%.

"At the end of the 18 month period, radiographic determinations showed almost the same result for the regular gum containing calcium carbonate as for the vitamin K gum. Clinical and radiographic findings together, however, show a marked advantage of the vitamin K gum at the 18 month period. On the basis of radiographs alone at the end of 18 months, the vitamin K gum reduced the caries 64% as compared with the extra control group and 89% as compared with the records of previous students. Clinical and radiograpic findings together at the end of 18 months show that the vitamin K gum reduced 42% as compared with the regular gum, 54% as compared with the extra control group, 89% as compared with the U. S. Coast Guard group and 72% as compared with U. S. Public Health figures. The last comparison is on the assumption that if 2.2 or 1.5 cavities develop in 12 months, 3.3 or 2.25 cavities will develop in 18 months (multiplying by a factor of 3/2). This assumption may not be valid, but it should be noted that the effect of the vitamin K gum is fairly constant in all comparisons, whatever the time interval."

The summary and conclusions of the experiments follow:

"1. The vitamin K gum reduced the occurrence of new cavities 60 to 90% depending upon the basis of comparison.

"2. The gum containing calcium carbonate, without vitamin K, reduced the occurrence of new cavities approximately half as much as the vitamin gum.

"3. The vitamin K gum probably did not inhibit the progress of caries already present.

"4. No effects contra-indicating the use of synthetic vitamin K were observed."[2]

In an evaluation of the efficacy of the chewing of synthetic vitamin K gum to reduce the dental caries-attack rate, it would be justifiable to state that one experiment alone often does not provide sufficient evidence to support a conclusion. The lack of a control of diets of the subjects may have permitted an unknown dietary effect. Since the subjects came from different areas, were not of the same sex, age and physical health, and were examined by different individuals, certain errors may have developed in the interpretation of the data gathered.

Since the gum containing the calcium carbonate also secured such good results in the decrease of carious-activity, possibly some other factor than vitamin K or calcium carbonate was responsible for the reduction, if such a reduction occurred.

Whether vitamin K therapy is effective in the promotion of good gingival conditions will have to be determined by further experiments with its administration. The first question to determine in any gingival condition is what causes the bleeding. If it is a vitamin K deficiency, one must determine next whether it produces a deficiency in prothrombin and, as a result, a prolonged bleeding time or a marked tendency to hemorrhage. Excessive bleeding may accompany a gingivitis when the condition has existed for a period before the deficiency of vitamin K began.

It has been demonstrated that the intravenous therapeutic use of vitamin K is effective in the treatment of sprue, an infection

which may cause hypoprothrombinemia. One of the marked characteristics of sprue is that of its oral manifestations. All patients at various periods of the disease are troubled with definite mouth lesions primarily consisting of definite small aphtha-like ulcers and a highly sensitive, inflamed and erd oed tongue.

"The aphthous ulcers appear as small, white areas of from 2 to 3 mm. in width with reddened areolas and they are situated on the tongue and sometimes on the cheeks or on the floor of the mouth. The mucous membrane near the buccal region of the molars shows at times an ulcerated raw surface covered by a yellowish slough. However, every variety of severe inflammation following the simple desquamation may be occasionally observed.

"In the acute stage of sprue the dorsum of the tongue frequently assumes a smooth, red, glistening color, i.e., it loses its epithelial cover, representing a type of mucitis which at times involves its tip and the edges, or restricts itself to one side only."[1, 3]

Since Vitamin K is effective in the treatment of sprue, one can assume that it may influence the oral conditions of the mouth.

It should be remembered that vitamin K is related to hemorrhage only through its effect on clotting (prothrombin). The hemorrhage itself is due to trauma or other causes (scurvy), the bleeding increasing or persisting to a greater extent than would occur otherwise because of inadequate clotting.

There has been one experiment carried out to date in which orally administered doses of vitamin K were ingested daily for extended lengths of time and the subjects of this experiment were rats. The experiment was conducted simultaneously at 2 institutions, Northwestern University School of Dentistry and University of Rochester School of Medicine and Dentistry. Certain conditions were maintained: (1) Control and test animal groups were used, (2) Dietary levels of the test material were kept at a point where no toxic effects appeared, and (3) The experiment was continued through 3 generations of rats.

The teeth of the rats of all 3 generations were examined and the teeth of the first 2 generations were so badly eroded and broken down that no accurate examination could be made. No significant differences were observed in the condition of the teeth from the third generation. The conclusion was reached that no differences could be observed in the incidence of caries in the test and control animals.

Another experiment was performed with rats in which the dietary values of the test material had toxic effects and each group of rats was fed a different level of menadione, a derivative of vitamin K. That experimental caries develops equally in rats fed various levels of menadione, was the conclusion reached.

In both of these experiments caries occurred. If vitamin K has any characteristic that would inhibit the dental caries-attack rate in rats, it should have manifested itself in these experiments. In past experiences the rat has been a perfect subject in dental caries experiments and an excellent subject in which to increase and decrease caries activity, especially by controlled diets.[4]

Oral administration of vitamin K seems to provide the best method for medication with this substance. Therefore, it appears that products such as, chewing gum, dentifrices, mouth washes or sugar, in which vitamin K is incorporated appear to be good vehicles. The factors involved in such a decision are (1) ease of administration, (2) the effectiveness of mastication to force the product into inaccessible places in the oral cavity, (3) the simulation of an alkaline saliva, and (4) the ready acceptance by the public.

The possibility of controlling caries in very large groups of people in the past has seemed quite remote. If the synthetic vitamin K were incorporated in a lozenge or chewing gum, its efficiency would depend upon the cooperation of the individual to follow instructions.

It has been demonstrated in 2 experiments that synthetic vitamin K has no persistent effect on the Lactobacillus acidophilus counts in the mouth. If this conclusion is valid, it raises a question regarding the effectiveness of synthetic vitamin K in controlling caries. In the past, certainly, the presence of Lactobacillus acidophilus in the mouth has been a reliable index of dental caries. This is a major

question which will have to be answered in any further investigations of the effectiveness of synthetic vitamin K, although preliminary investigations indicate that this phenomenon may be related to the action of ammonia in inhibiting the action of aciduric organisms.[2, 5]

Another use of vitamin K in dentistry is the pre-medication of the patients with low prothrombin content before oral surgery is performed. Premedication should raise the prothrombin levels and thus control post extraction hemorrhages.[5]

It has been found that the administration of acetylsalicylic acid has some toxic effects, especially in those having an idiosyncrasy to the drug. Severe reactions are rare, but there is evidence that the ingestion of acetylsalicylic acid and other salicylates frequently does cause physiologic changes in that it brings about a decreased prothrombin in the blood. Link and his co-workers, trying to determine the effect of the administration of salicylic acid on rats on diets deficient in vitamin K, found a decrease in prothrombin. If the salicylic acid were given over a long period, hemorrhage developed. If vitamin K were administered, the prothrombin did not decrease and no hemorrhage occurred.

These same results have been observed in human beings. Salicylate administration has caused hypoprothrombin, which can be prevented by simultaneous administration of vitamin K. Once excessive bleeding has occurred after the use of salicylates or acetylsalicylic acid, vitamin K is of little use. This vitamin then, is to be used as a prophylactic agent.

Since the use of aspirin is such a universal habit, it is difficult to get a clear idea to what extent it does produce a hemorrhage tendency, but it would seem necessary in all cases of obscure hemorrhage to inquire if aspirin has been taken.

All dentists and oral surgeons, prescribing acetylsalicylic acid, should incorporate vitamin K in their prescriptions. In this way, unnecessary bleeding may be prevented.[6]

The literature on vitamin K indicates that the human organism is not apt to suffer a vitamin K shortage. The amount that the body requires is unknown, but it appears to be around 1 mg. daily. In a normal diet of natural foods it would be exceedingly difficult not to obtain enough of the vitamin K. Furthermore, the intestinal bacteria are constantly synthesizing this substance probably in amounts sufficient for normal needs.[6, 7, 8]

Any diseased condition of the liver or intestines will interfere with the assimilation of vitamin K by causing defective absorption or impairment of its utilization for the production of prothrombin.[9]

## Conclusions

1. Further research is required to ascertain the processes by which vitamin K may accomplish an effective reduction or the prevention of oral conditions.

2. It may be questioned that one experiment with the use of synthetic vitamin K in chewing gum provides sufficient evidence to support the conclusion that vitamin K reduces the dental caries-attack rate.

3. Vitamin K will improve gingival conditions in which the bleeding is due to a low prothrombin content of the blood.

4. Prolonged ingestion of synthetic vitamin K in the diets of rats did not show any inhibitory effect on dental caries.

5. Lactobacillus acidophilus counts were not affected by the action of synthetic vitamin K in the mouth.

6. The human organism is not apt to suffer a vitamin K shortage unless some diseased condition of the liver or intestine exists.

## BIBLIOGRAPHY


1. Dam, Henrick, and Doisy, Edward. The Noble prizes. Science suppl., 100:10, Nov. 10, 1944.
2. Burrill, D. Y., Calandra, J. C., Tilden, E. B., and Fosdick, L. S. The effect of a 2-Methyl-1, 4-Naphthoquinone on the incidence of dental caries. J. Dent. Res., 24:273-82, Dec. 1945.
3. Prinz, Hermann, and Greebaum, S. S. Diseases of the mouth and their treatment. Philadelphia, Lea and Febiger, c 1935. XIV/602 p (p. 345-8).
4. Hatton, E. H., Dodds, A., Hodge, H. C., and Fosdick, L. S. The effect of prolonged ingestion or synthetic vitamin K on rats. J. Dent. Res., 24:283-95, Dec. 1945.
5. Hoffman, O. E. The effect of cerophyl on the L. acidophilus of the oral cavity. J. Dent. Child., 13:49-52, 2nd Quar. 1946.
6. Cahn, Lester. Acetylsalicylic acid (aspirin) as a cause of bleeding. J. Oral Surg., 3:336-8, Oct. 1945.
7. Quick, A. J. The clinical application of the hippuric acid and the prothrombin tests. Am. J. Clin. Path., 10:222-34, Mar. 1940.
8. Editorial. Vitamin K. Am. J. Orthodont. and Oral Surg., 27:595-7, Oct. 1941.
9. Clark, R. L., Dixon, C. F., Butt, H. R., and Snell, A. M. Deficiency of prothrombin associated with various intestinal disorders: its treatment with the anti-hemorrhagic vitamin (vitamin K). Proc. Staff Meet. Mayo Clin., 14:407-16, June 28, 1939.

## Summary of Membership, October, 1946

| *STATE* | *Number Members* | *Number in Service* | *1946 Drops* |
|---|---|---|---|
| Alabama | 3 | .. | .. |
| Arizona | .. | .. | .. |
| Arkansas | 1 | .. | .. |
| California | 104 | 3 | .. |
| Colorado | 1 | .. | .. |
| Connecticut | 7 | .. | .. |
| Delaware | 1 | .. | .. |
| District of Columbia | 10 | .. | .. |
| Florida | 2 | .. | .. |
| Georgia | 7 | .. | .. |
| Idaho | 1 | .. | .. |
| Illinois | 21 | .. | 2 |
| Indiana | 6 | 1 | 1 |
| Iowa | 4 | .. | 1 |
| Kansas | 1 | .. | .. |
| Kentucky | 4 | 1 | 1 |
| Louisiana | 12 | .. | .. |
| Maine | 3 | .. | 1 |
| Maryland | 3 | .. | .. |
| Massachusetts | 79 | 1 | 5 |
| Michigan | 56 | 1 | 8 |
| Minnesota | 23 | .. | 2 |
| Mississippi | 1 | .. | .. |
| Missouri | 40 | 1 | 1 |
| Montana | 8 | 1 | 1 |
| Nebraska | 19 | .. | 5 |
| Nevada | 2 | .. | .. |
| New Hampshire | 4 | .. | .. |
| New Jersey | 34 | .. | 11 |
| New Mexico | 2 | .. | .. |
| New York | 153 | 1 | .. |
| North Carolina | 1 | .. | .. |
| North Dakota | 1 | .. | .. |
| Ohio | 27 | .. | .. |
| Oklahoma | 1 | .. | .. |
| Oregon | 17 | .. | .. |
| Pennsylvania | 57 | .. | .. |
| Rhode Island | 5 | .. | 1 |
| South Carolina | 1 | .. | .. |
| South Dakota | 1 | .. | .. |
| Tennessee | 18 | .. | 3 |
| Texas | 21 | .. | 3 |
| Utah | 3 | .. | 1 |
| Vermont | 2 | 1 | 1 |
| Virginia | 2 | 1 | 1 |
| Washington | 8 | .. | .. |
| West Virginia | 1 | .. | .. |
| Wisconsin | 4 | .. | 1 |
| Wyoming | 1 | .. | .. |
| Canada | 13 | .. | .. |
| Foreign | 29 | .. | 4 |
| Universities | 43 | .. | .. |
| Mexico | 2 | .. | 4 |
| Dental and Other Health Associations | 16 | .. | .. |
| Total | 887 | 12 | 58 |

# THE CHILDREN IN OUR MIDST

In early history one reads but very little of efforts to care for the medical and dental needs of children and the childhood diseases and travail were, I suppose, accepted as necessary to provide immunity in Nature's own way, to the afflictions of adulthood. But a sense of responsibility has gradually grown into our personal and public thinking, until now we accept the care and education of the children in our midst as our personal and public obligation. We have collectively encouraged the passage and supported the principles of child labor laws, compulsory education and immunization against contagious diseases. We support the movement for the detection and treatment of infantile paralysis to the point that the Birthday of a President of the United States becomes the occasion for nationwide contributions to extend and sustain research and provide facilities for treatment of victims of the dreaded affliction. One need not look far to see evidences of our regard for the children of our Nation.

But what about organized Dentistry—which is really you and I—have we accepted and met our obligation to the children in our midst—or have we verbally accepted it and then promptly forgotten to discharge it faithfully? I am inclined to think the latter is usually the case.

The basic source of the recognition of the individual dentist's obligation to children should be the schools of dentistry in our Country. Most of us entered the study of dentistry because first of all we had a sincere desire to serve our fellow men and secondly because we wanted to earn a fair income and achieve a certain social status. We knew but very little of the obligation we would assume with the awarding of our own dental degree, but we were willing to learn!

Dental students haven't changed much in the past years, and for the most part they're just like we were. But many of them possess a broader pre-dental education and should be quicker to accept their obligations to society because of the advancement in social consciousness in the past decade. Are the dental schools progressing with their teaching of the obligation of a dentist to care for the dental needs of our children? Or does the majority still devote almost twice as much time in the first three years of school to denture and crown and bridge construction as to operative dentistry, including dentistry for children?

No school of dentistry should be satisfied with its program, its accomplishments or its contribution to dentistry or society as a whole, unless its graduates have had an adequate amount of good, sound teaching in dentistry for children and have been taught their personal and collective obligation to care for the dental needs of the children in our midst.

But education is for the older dentist as well as for the young student. It centers in youth, because it is recognized that there the most productive work can be done; but there does exist a definite need for education of this type among the older dentists too. Someone has said that our biggest educational problem is the training of dentists already in practice. There is a need for capable and willing older members of our profession to accept their obligation to the children in their midst, and by example, to instruct the younger men and recent graduates. We so often hear the older men insist that the necessary dentistry for children should be done, but these very men do not accept their own obligation by practicing what they preach. It would seem that if these men were really sincere in their expressions, they would be paragons of virtue, as it were!

It is in this field of continuing education that State and local dental societies must recognize their responsibilities. No dental society should be satisfied with its programs and accomplishments unless it stresses the importance of good dentistry for children and offers to its members sound clinical and lecture material.

It should be the firm resolve of every member of the American Society of Dentistry for Children that every available opportunity be used to impress his fellow dentists with their obligation to the children in our midst and to faithfully discharge his own.

A.E.S.

## NEW MIDGET APPLICATORS

The rules and principles of careful application now developed to a high degree.

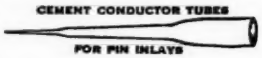
Usefulness extended, especially to anterior teeth.

Fear of stain has often prevented the use of Ammoniacal Silver Nitrate in anterior teeth.

Provides a safe method for using Formalin.

Use Midget Applicators for safe, clean operations.

NEW ITEM




Pin Ledge Cement tubes for Pin-Ledge Inlays, or Root Canals—36 tubes in each box.

P. N. Condit,
Box 204, Back Bay,
Boston 17, Mass., U.S.A.

Please send the following and charge my Dealer:

*Name*.....

*Address*.....

*Dealer*.....

## "MAKE-TRICKS"

Two-surface fillings made simple as occlusal.

No cutting or wedging discomfort.

Matrix bands designed for deciduous molars are self-retaining.

Retainers and bands can be used many times.

12 retainers and 20 bands per set—$1.00.

*The trick is in the "Make-Tricks"*

**CRESCENT DENTAL MFG. CO.**

**1839 S. Crawford Ave.**
**Chicago 23, Illinois**

# AROUND THE COUNTRY

"From refreshments back to labors again." Now that the summer months have passed on, our fancy turns to the more serious side of life. We know where some of the boys have been for "refreshments" and we can bank on all the boys doing a real job of dentistry for children these coming months.

## Vacationers

Editor Al enjoyed what he calls "his first vacation in five years." (Note—I thought he had been on a continuous vacation for years!)

*Al* and his good wife *Louise* vacationed "down on the farm" in central Ohio. They arrived in time to officiate at the "ring" ceremony of some seventy pigs. *Al* also *helped* in the first process of fattening male pigs. (You farmers will recall this surgical operation, and it is not "pulling teeth.")

*Frank Tuma,* of Cleveland, purchased a new sail boat cruiser this spring and with his wife has been spending quite some time on the Great Lakes. In July they made the beautiful cruise through the Lakes to Detroit and visited with *Al* at the D.Y.C. Oh for the life of a sailor!

*Carl Miller,* wife *Lydia* and son *"Butch"* spent a cold vacation at Crystal Lake (near Frankfort, Michigan). The merry month of August was rather cool in parts of Michigan, yet *Carl* says he was greatly refreshed by the experience.

*Carl* has again been called upon for a very busy season of amalgam clinics. If you have not heard him you should place this item of business on your "must" list. *Carl* gives you practical stuff and certainly amalgam is our most prolific item of service in dentistry for children. I urge you to make special effort to hear and see him.

*Gordon Johnston,* of Toronto, refreshed himself in the mountains. *Gord* plans to attend the Detroit Dental Review, November 4-5, as a "refueling station" for his new position as Assistant Professor, Children's Department, University of Toronto.

*Fred Baker* and wife *Merle* of London, Ontario, plan a few days in Michigan golfing and exchanging ideas with *Doctor Theunissen* and your roving reporter.

*Walter McBride* takes no summer vacation except an occasional weekend visiting the old homestead "back on the farm". Incidentally, you might be interested to know that *Walter's* brother is sheriff of Huron County.

*Joseph Kaufmann* (New York) reports that he too has returned from a short vacation. Didn't say how many fish he lost! He does report his appreciation for the fine Journal *Al* is preparing, and would like to see at least a thousand dentists on our membership list.

*Joe* is very interested in the "activities throughout the country."

*All* members are interested, so why not send in your doings to the reporter?

*George Haymaker,* wife *Ruth* and son *George Jr.* (Sharon, Penn.) made a short visit with the *Browns* of Ithaca. *George* and *Stan* are much interested in the use of the rubber dam in children's work, so they had plenty of notes to compare. The *Haymakers* spent an abbreviated vacation in Michigan's Upper Peninsula region.

## In the News

*Walter McFall* was our ambassador to the California State meeting in April. As *Charlie Sweet* would say, "He went over big, as usual."

*Charlie Sweet* of California, covered the field for us at the Tennessee and Georgia State meetings. *Frank Lamons* acted as General Chairman and did a marvelous job by all reports. These program chairmen sure get h - - - if the meeting flops, but who gives them credit when it clicks?!!

*Charlie Sweet* also appeared before the Southern California unit twice this past year and was on the Utah State meeting in June. For an old timer *Charlie* still gets around and really gives the boys practical food for thought.

To quote *Charlie*: "The best news I have is that *Charles Jr.*, graduated from the College of Physicians and Surgeons in July and if the armed services do not take him first he will come into the office and I will try to put the pack on his back." (Told you *Charlie* was a wise old boy!)

## Here and There

*Ralph Wagner* is the new President of the California State Dental Association. We also understand that *Dave Julienne* has returned from his overseas duties and is happily established in his old location, Hayward, California.

*Commander W. J. Pelton,* PHS, 2408 U. S. P. H. S. District No. 8615 Colorado Building, Denver 2, Colorado. What a mouth full! (A pleasant one too.)

Many of our A. S. D. C. members have had the pleasant privilege of learning much about health dentistry for children from *Jack's* refresher courses. You fellows in and near Colorado, Wyoming, Montana and Nevada would find it most profitable to attend one of his refresher courses.

*Jack* and *Bee* (his fine wife) purchased a new home in Denver and are looking for someone to manicure their lawn. By the time this column appears they will have returned from their first field trip in the Eighth District.

*Kenneth E. Lawrence* announces the opening of his office at 6305 Brookside Plaza, Kansas City, Missouri, limiting his practice to dentistry for children.

*Ken* will find a fine piece of ground work in public education and appreciation for children's dentistry, as Missouri is the old stamping ground of *Allen O. Gruebbel,* who is noted for his outstanding children's program in Missouri.

*Philip Blackerby,* Kellogg Foundation, attended the banquet honoring the Latin-American dentists at the Mayflower Hotel, Washington, D. C. This marked the completion of the third eighteen weeks inter-American post-graduate course in dentistry at the University of Michigan. The W. K. Kellogg Foundation is one of the sponsors of the program.

*Phil* will assist in the publication of a quarterly magazine sponsored by the Endodontists Association, titled "Journal of Endodontics," edited by *Balint Orban,* Chicago.

Our genial friend *Lon Morrey,* addressed a session of the Health Education Workshop at Illinois State Normal University. Said *Lon,* "A sound dental health educational program can be provided in all schools for a few cents a year per child." Such a program does not include operative services for the children, but consists primarily of dental health education, examinations and referrals to family dentists or dental clinics.

Our A. S. D. C. is cooperating with *Lon* in preparing a manual of operative procedures for children's dentistry. With this manual as a guide, every dentist can produce a creditable service for children if he will apply himself.

Our friend *John C. Brauer,* with the Reserve title of *Lt. Col.* was requested by the historical division of the office of the Surgeon General to aid in the preparation of a special clinical and technical section designed for professional readers of "Medical History of World War II." *John* will be a leading factor in the preparation of the dental phase of the report.

The Red Cross in Canada has turned to dentistry for peace time endeavors. In the Welland District, Ontario, the Management Committee of the Red Cross Society has appointed the enthusiastic Chairman of the Dental Public Health Committee, *Doctor S. A. MacGregor* to their Board. *Sandy* is a member of A. S. D. C. and will give a good account of children's dentistry in all Board decisions.

*David B. Ast,* Chief of the dental bureau of the New York State Health Department, has left for Europe, where he will aid in the dental rehabilitation of displaced persons under the direction of the American-Jewish Joint Distribution Committee.

## New Members

From the Massachusetts Unit we welcome two new members of the Forsyth Dental Infirmary for children—*Drs. Frank C. Besic* and *Veikko Hurme.*

*Frank,* the new Chief of the Dental Clinic,

is a graduate of the University of Illinois College of Dentistry, class of 1934. He is well qualified for his new position, having been engaged in part time private practice along with teaching and research work at Illinois. He is married and the father of two children —a most commendable experience qualification for dentistry for children!

*Veikko Hurme* is the new Director of Research. He graduated from Tufts College of Dentistry in 1935, returning to his Alma Mater as instructor in Operative Dentistry and Research Assistant. Later he was Resident Interne in Dental Surgery, New Haven Hospital. Also he has been Consultant of the Children's Bureau of the U. S. Department of Labor. Is married and father of two sons.

Welcome *Frank* and *Veikko* and congratulations, Boston!

Tuesday, October 1st, *Doctor Robert L. Heinze* (a member of the New York Unit) was heard over radio station WNYC, New York. Subject—"The School Child's Teeth." A timely subject by a well qualified speaker.

## Unit News

Under the inspirational leadership of *Walter McBride,* President, our Michigan Unit plans a full year of activity. Program Chairman, *Sam Stulberg,* announces the following events. October 2nd., Wardell-Sheraton Hotel—*Doctor Elwood A. Sharp* will present a sound color movie on "Endocrinology." Although definite dates have not been set, the following programs are planned: *Doctor Harold Bloomer* will present "Speech Rehabilitation," *Doctor Louis Himler* will lecture on "Mental Hygiene in the Dental Office."

On October 10th., our Past President, *Ralph Ireland,* appeared before the Detroit District Dental Society. Michigan Unit members presented allied pedodontic subjects during the afternoon session. *Joe Hartsook, Ed Cheney, Al Richards* and *Sam Stulberg* were the participating clinicians.

On the Dental Review program November 4 and 5, limited attendance clinics will be presented by *Joe Hartsook* and *Sam Stulberg.*

*Clare (Gus) Edmunds* is back in private practice at his old office in Detroit, after almost 3 years' services in the Army which took him to both Okinawa and Korea. With a prayer of thanks for his safe return, we welcome him back to active membership in our Michigan Unit.

*Stan Brown,* who gathers the news for this column, is really getting around, appearing on the program at Tyler, Texas, early in October, and in Charlotte, North Carolina on the 21st. There'll be lots of rubber dam used in dentistry for children if *Stan* has his way about it—even if he can't sell *Walter McBride* and *me* on the idea!!—A.E.S.

Back to Nebraska and his old position as Director of Division of Dental Health for the State Department of Health, has gone *J. R. Thompson.* His many friends welcome his return.

As Instructor in Pedodontics, the University of Nebraska has called *Earl Lamoshire,* a recent graduate. (Just a friendly tip, *Earl*—be sure to laugh heartily at those corny stories of your boss, *Ralph Ireland!!*—A.E.S.)

---

Here's a suggestion for a real service to dentistry for children—our Southern California Unit Secretary Barnes, advises us that his Unit will present the Journal to 15 members of the Senior Dental Class of U.S.C., and that reading assignments in our Journal are being made by the faculty. Congratulations to you farsighted men of Southern California!

**This department is conducted by Stan Brown. Please direct items of interest to him at Ithaca, Michigan.**

# Teething and Its Significance

HENRY J. KRUSKA, D.D.S.

*Editor's Note:*

*Uncle Hank Kruska, nee 1916, hails from the salt mines of Manistee, Michigan. Although the influence of Hank's Dad, now Dean of Alliance College in Pennsylvania, led Hank through 3 years of engineering, he finally switched over to his first love, dentistry, and after graduation from the University of Michigan School of Dentistry, remained for four years as instructor. While earning his M.P.H. degree he did work on the fluorides—topical application and mouth wash. Bristol, Indiana is now being treated to good dentistry by Dr. Kruska, and if his wife can find a home there for their 9 months old daughter Sally Jo, Hank plans to anchor permanently, playing the stock market in an effort to augment his earning power to provide sufficient funds for extended vacations by water and air travel. A.E.S.*

Teething is one of the controversial problems one finds in dentistry and medicine. There are or have been three distinct factions reacting to this problem. One group claims that teething produces nothing but teeth while others think that it may cause any symptom, from ill-nature to convulsions, exhibited by a child at this age period. A third group takes a middle course and is convinced that only a few disorders are due to teething.

The oldest group is that which thinks teething can produce a large number of symptoms. As one goes back into the literature 75-100 years ago he finds that most of the articles and space in textbooks were devoted to the many symptoms of pathologic dentition. As the science of medicine progresses and the diagnostic ability of the medical profession improves one finds that the diagnosis of pathological dentition becomes less frequent. Today the amount of space devoted to the pathological symptoms in medical and dental books and journals has become exceedingly small.

Scientific facts seem to verify the stand of those who think that teething produces only a few minor symptoms.

The amount of reliable research on the subject of teething is very small indeed. Those who think that teething can cause many harmful results have produced a number of theories concerning the etiology of the numerous symptoms. Some of these etiological theories follow:

1. Distressing symptoms that often occur during dentition are a direct result of the nervous irritation, local and reflex, produced by pressure of the erupting teeth.[2]
2. The primary cause of pathological dentition is due to an inequality in the rate of gum absorption and crown advance. The advancing crown pressing upon the resistant gum tissue causes irritation. This irritation results in swelling of the gum which, pressing upon the crown, depresses it upon the pulp beneath the sharp root margins. At the same time the blood pressure of the tissues involved tends to press the tooth upwards. The simple lack of resorption of the gum is sufficient to prevent eruption. The sharp edges of the root irritate the sensitive and delicate pulp tissue which becomes inflamed and tumid and still more strongly urges the tooth upwards. Thus there are two sources of disturbance—the irritated gum tissue and the irritated pulp. The inflamed gum is often capable of producing local symptoms and the pulp inflammation may give rise to diverse reflex phenomena as it is supplied by the fifth cranial nerve which is in intimate relationship with the sixth, seventh, ninth and tenth cranial nerves in and about the floor of the fourth ventricle. Thus salivary, muscular, nervous,

alimentary and pulmonary disturbances become possible.[17]

3. Infection of the dental follicle is the etiological factor of teething disturbances since it has been demonstrated that pus can form in the dental sacs during the eruption of the primary teeth.[15]
4. The disorders due to teething may be due to a reflex mechanism through the reflex tracts present in the trigeminal network, thereby producing symptoms reflexly in the eye and ear.[7]
5. The tooth acts as a foreign body, and creates pain and other disturbances by forcing its way through closely packed teeth.[14]

These are strictly theories which have little foundation in scientific research.

The physician appears to be responsible for the popularity of the notion that teething produces illness.[10] A hundred years ago mortality rates as high as 50% were reported due to teething. To-day Schwartzman finds an incidence of 0.37%. This decrease measures the amount by which medical knowledge has increased in this one area. Similar situations can be found in other fields. During the last World War "shell shock" was a very common condition among the soldiers. With the advancement in psychiatric diagnosis today one finds no cases of shell shock in the present war. In aeronautics, when airplanes were in their infancy, many crashes were listed as the result of the airplane striking an air pocket. To-day one never hears of airplane crashes due to air pockets. All these changes came about with increased knowledge of the conditions that really exist.

In teething, which extends over a considerable period of time, through the sixth to the twenty-fourth month, anything that affects the infant's health can be associated and attributed to difficult dentition, when actually teething and the illness may have been merely coincidental.[16, 10, 5] To-day the etiology of most of the symptoms that were laid to teething is known.

Intestinal upsets and diarrhea are less common in infants than in years past mainly because of better sanitary conditions. Bottles and nipples are sterilized. Pathogenic bacteria in milk are eliminated through pasteurization and the bacterial content of milk is maintained at a low level by refrigeration. Diets scientifically balanced and well prepared are used.[4] When diarrhea and intestinal upsets do occur they are not due to teething.[5] Some bacterial infection or some food that the infant should not have eaten is responsible for the symptoms. If the stools are examined one probably will find undigested pieces of apple or potato which the mother thinks could not have been eaten by the infant.[6, 1]

Most children are weaned between four months and one year of age. It is during this period that 55-60% of the symptoms laid to teething occur. The diarrhea and intestinal upsets probably are due primarily to the change in diet and not to teething.[10]

Drooling and increased salivation generally begins before teething and is not due to teething but rather to the beginning function of the salivary glands at this age and the failure of the infant to learn how to handle his saliva.[6, 9, 10]

Skin disorders often are due to conditions other than teething. In the first place the skin of the infant is extremely delicate and sensitive. A small insect bite can cause an unusually large area of erythema. Saliva drooling from the mouth can cause considerable irritation. Intestinal conditions and diet very frequently are the cause of skin disorders but not teething.[6]

Sucking and chewing on the fingers are no symptoms of teething but rather a gratification of one of the infant's first impulses and one of his most pleasurable instincts—feeding.[11, 6, 10]

Ulcerative stomatitis, which is rare in infants, occurs because of contaminated feeding bottles and poor oral hygiene. Teething has no direct connection.[5]

Fever in a child can be due to almost anything.[5] The child, in a developmental condition and a rather unstable physiological equilibrium can easily be upset by very minor disturbances. Generally the eruption of teeth is not sufficient cause for a rise in temperature. The temperature rise is due to coincidental illness.[1, 8]

Convulsions are practically never due to teething.[2, 6] Convulsions occur in children

who have abnormal electrical brain waves. It is estimated that 10% of people have abnormal brain waves, but only about 1% of them have convulsions while they are adults. During infancy a larger percentage have convulsions because the nervous system is not matured until approximately three years of age. Previous to this age any slight fever irritates the immature brain and nervous system and convulsions result, provided that the predisposing factor of abnormal brain waves is present.[11]

a. E. E. Himler, M.D., Associate Psychiatrist, University of Michigan Health Service. A personal communication.

In only 25% of the cases can the actual cause of convulsions be found such as lack of sugar, calcium, or phosphorus, or the presence of a tumor.[1, 11] Some cases of convulsions have resulted from an immunization injection and the infant never experiences another convulsive attack during his entire life. As the infant's nervous system completes development he outgrows convulsions, although he still possesses abnormal brain waves.[11, 10]

It has been reported many times that convulsions have been stopped by lancing the gums over developing teeth. Actually, if the convulsions stopped after lancing, they would have ceased from some very simple treatment such as a warm bath. If nothing else will stop a convulsive attack, lancing the gums will not do so. Instances have been reported in which lancing of the gums brought on convulsive attacks.[6]

Mothers need to be educated in the treatment of infants whom they think are suffering from a teething disorder. They should be warned against the purchase of "teething lotions" or any patented medicines which are supposed to make teething easy. These products generally contain potent drugs which by indiscriminate usage may prove to be harmful.[18]

The best treatment that the mother can render is to keep the infant in a normal, clean and healthful environment, properly clothed and fed with wholesome uncontaminated food with special emphasis against overfeeding or overclothing.[3] Cleanliness of the utensils used in the preparation of the food should not be overlooked. In other words, the mother need only keep the child in the best of health. Mothers who attempt to rub the tooth through the overlying gum should be discouraged from this practice. It is very apt to introduce infection into the tooth crypt even if sterile gauze is used around the finger.[9, 13]

Lancing the gums should be abandoned. It rarely, if ever, does any good.[9, 12, 16, 6] Parents should not attempt to persuade their physician or dentist to lance their child's gums. On the contrary, they ought to be enlightened to the point that they question any dentist or physician who attempts to use the lance.

About all that the child requires to cut his teeth is something hard to chew. Some food substance which will do no harm if swallowed such as a piece of hard toast is ideal.[12]

Any symptoms occurring during the teething period should be treated as an illness and the condition should not be neglected because of the assumption that the teeth are to blame. Taking care of the infant, with, the aid of a physician, treating the symptoms and attempting to locate the source of the trouble make for sound procedure. The teeth should be forgotten.

## BIBLIOGRAPHY


1. Bloom, C. J. The evaluation of teeth in pediatrics. Tri-State Med. J., 11:2345-51, Sept. 1939.
2. Brewer, Howell, and Akers, Lawrence. Surgical dentition, symptomatology, diagnosis, and treatment; Its probable influence upon infant mortality. Tri-State Med. J., 11:2302-6, June 1939.
3. Burchard, H. H. Text-book of dental pathology. 5th ed., Philadelphia, Lea and Febiger, 1937. 807 p. (p. 198-208).
4. Casparis, Horton. Round table discussion on diarrhea and dysentry. J. Pediat., 17:687-8, Nov. 1940.
5. Colyer, J. F., and Sprawson, Evelyn. Dental surgery and pathology. 6th ed., New York, Longmans, Green & Co., 1931. XIV/908 p. (p. 1-15).
6. Forchheimer, Frederick. Diseases of the mouth in children. 1st ed., Philadelphia, J. B. Lippincott, 1892. 199 p. (p. 124-67).
7. Garard, H. T. The role of dental pathology in certain diseases of the eye, ear and sinuses. Eye, Ear, Nose and Throat Monthly, 17:197-9, July 1938.
8. Grulee, C. G. Oral disease in children. Am. Dent. A. J., 22:1226-31, July 1935.
9. Heiman, Henry. Dentition as a normal physiologic process. Pacific Dent. Gaz., 30:565-8, Oct. 1922.
10. Herman, Charles. Teething as a cause of disease in infancy. N. Y. Med. J., 97:497-8, Mar. 8, 1943.
11. Himler, L. E. Lecture notes in Introduction to Mental Hygiene. (P. H. P. 220) Summer Term, 1943.
12. Millberry, G. S. The teeth, V. 3, chapt. 3, p. 1-28 (In Brennemann, Joseph, ed. Practice of pediatrics. Hagerstown, Md., W. F. Prior Co., 1942. 4 V.)
13. Noyes, H. J. Round table discussion on dental caries, the disease and its significance as an indication of nutritional adjustment. J. Pediat., 14:118-33, Jan. 1939.
14. Schwartzman, Joseph. Dentition in infancy. Med. Rec., 5:150-2, Mar. 1939.

# Toothbrushing: Its Effect on Gingival Tissues

JOSEPH CABOT, D.D.S.

*Editor's Note:*

*Joe Cabot, another University of Michigan alumnus, is now back at his Alma Mater for a full year of post graduate work in Pedodontics under the sponsorship of the C. S. Mott Foundation in whose Children's Health Center at Hurley Hospital in Flint, Michigan he served following his graduation and prior to his return to Ann Arbor. Joe, a prominent Alpha Omegan, is quite an athlete, and participates in many of the contests between the boys at A² and the U. of D. He is a member of our Michigan Unit and active in its program.*

*A.E.S.*

The history of the toothbrush goes back to the time of the ancient Chinese civilization. At that time its purpose was merely the polishing of the teeth. Through the ages it has evolved with many changes in design and materials.

The present day use of the toothbrush, it is said, revolves about two main functions. The first is the mechanical cleansing of the teeth themselves in an attempt to reduce and prevent the occurrence of dental caries. The second is the beneficial stimulation of the gingival tissues. It is with this latter function that this paper is concerned.

This review of the available literature is an effort to determine whether the present dental health education is based on accurate scientific knowledge or personal opinion. Any conclusions that are drawn will indicate that which can be taught as scientific truth, and perhaps draw attention to areas in which more research is desirable.

Certain questions, it would appear must be answered in order to establish the value of the toothbrush. They follow:

1. How effective is toothbrushing as a measure to prevent the deposition of calculus?
2. How is calculus formed?
3. How effective is toothbrushing as a measure to prevent stains?
4. How effective is toothbrushing as a measure for the prevention of gingivitis or pyorrhea?
5. How often should the gums be brushed to maintain a healthy gingival tone?

In 1935, Bibby[1], after reviewing the experimental work which had been reported to date, proceeded with accurately controlled experiments, to discover the mechanism whereby calculus was formed. He concluded:

"No single cause has been found which will account for the formation of salivary calculus. By assuming the interaction of certain physico-chemical and bacteriological factors, however, most of the phenomena concerned with the deposition and distribution in the mouth can be satisfactorily explained. It is suggested that physico-chemical processes lead to the initial precipitation of calcium salts from the saliva, while bacteria are important in fixing these precipitants in firm calculus deposits on the teeth."

From the work of Bibby, Box[2], concluded, without the presence of microorganisms, that no deposits of calculus can be formed, and that leptothrix organisms predominate in calculus. He found also that some of the phenomena of calculus formation cannot be explained on a bacterial basis. Box maintained that the presence of certain factors in gingival crevices and pockets, "from a hypothetical standpoint at least," furnish a favorable basis for the formation of calculus on the tooth surface. These factors are: (1) calcium salts in solution of colloids, (2) adherent vegetations of leptothrix organisms on the tooth surface, which will fix the precipitates

of calcium carbonate and calcium phosphate, and (3) a rise in pH of the pocket solution which will allow for the precipitation of the calcium salts from the saliva by the loss of carbon dioxide.

Rapp[3] indicates, in a well regulated study of salivary calculus, that calculus is composed chiefly of calcium and phosphorus salts with some carbonates and mixed organic matter. This conclusion coincides with those of Bibby and Box. Rapp summarizes his work by indicating that calculus-positive individuals, as determined by accurate measurement, show a lower salivary pH than do calculus-free individuals. He states:

"The excretion of calcium is determined largely by the calcium intake, body requirements and the 'calcium threshold' of the salivary glands."

Kronfeld[4], indicates that the tendency of calculus to form varies greatly with different individuals. Some mouths are practically free of it; in others, calculus forms very rapidly despite frequent removal and good oral care. The reason for these individual differences probably can be explained by one of Rapp's conclusions that only a little additional alkalinization is necessary to cause a precipitation of large amounts of insoluble calcium phosphate. Kronfeld states, also, that the deposit consists of desquamated epithelial cells, food debris, mucin of the saliva, and microorganisms of the oral cavity. He continues:

"It has been proven beyond doubt that the primary step in the formation of calculus is the deposition of a delicate soft film of these substances, that at first can easily be wiped off in mastication or with a toothbrush, and that the secondary step is the calcification and hardening of the film by the deposition of calcium salts from the salivary fluids. If the forming organic film is carefully removed with a toothbrush every day, the formation of calculus can be greatly decreased or inhibited."

Kronfeld, does not submit evidence of the initial step but if a delicate film is the first step, one may conclude that toothbrushing, practiced regularly and adequately will inhibit the formation of calculus in those mouths in which the pH is not highly favorable for its deposition.

Yoretsky[6], insists, after a review of the literature but with no report of any studies of her own: "Since calculus cannot be deposited upon the teeth in the absence of bacteria, it is essential to keep the bacterial count within the mouth low . . . Only careful and painstaking cleansing with the toothbrush and rubber stimulator can reduce the flora which foster bacterial growth."

One must agree with Johnson[5], that more research regarding the cause and prevention of deposition of salivary calculus is necessary.

Included among the many writers who have discussed stains are Thoma[7], McBride[8], Bunting and Hill[9], Bunting[10], and Ayers[11]. In most instances, however, all of the discussions concern the possible etiological factors and treatment by the dental practitioner. Numerous references have been made to the removal of stain from mottled enamel, but none of these methods includes the use of the toothbrush.

Bunting[10], referring to stains in general, states:

"The majority of stains on the teeth are extraneous to the enamel, being glued to the surface by mucoid films. When all such films and deposits are removed from the teeth, the stains will also be eliminated."

Only one scientific study of stains is reported, that of Ayers[11] on the green stain of thirty-five children. Many variants were considered which may influence the occurrence of green stain. Among these variants were nationality, diet, missing teeth, caries-susceptibility, occlusion and home care of the mouth, such as toothbrushing. All of the children had green stain and one very interesting factor common to all, was the lack of oral care. Eight had never used a toothbrush; seven cleaned their teeth once a week; one, twice a week; two, three times a week; and the remainder anywhere from four to twenty-one times per week. Thus, over half of the children brushed their teeth less than four times per week.

This finding in itself would seem to imply that toothbrushing is a causative factor or a preventive factor. However, since similar

observations were not made of children without green stain this conclusion cannot be accepted as statistically legitimate and consequently no scientific evidence is available in the literature to date to confirm the effectiveness of toothbrushing in the removal of stains.

Considerable material can be found in the literature concerning toothbrushing, but very little is of value to the practitioner, who wishes to rely upon scientific research for his dental health education material. The references, on the whole, may be divided into three groups: (1) the group concerned with the brush itself; (2) the one dealing with brushing technics; and (3) the one concerned with the effects of toothbrushing on the oral structures.

In the first group, the one concerned with the brush itself, is found the most accurate scientific research work. It includes work by McCauley[12], MacFarlane[13], who indicates that the supposed harm arising from nylon bristles can be remedied by the use of a narrower bristle, and Kaufmann[14, 15, 16, 17] who has given a complete study of the source material and the commercial aspects of the toothbrush. This information provides nothing regarding the effect of brushing on the gingivae.

In the second group, the one concerning the brushing technics, Kauffman[18], Strusser[19], Litten[20], Blass and Roth[22] and Ceci[22], have contributed. Except for the work of Blass and Roth none of these writers presents any research as the basis for their opinions.

It is only from the final group, the one concerning the effects of toothbrushing on gingival tissues, that one may expect to get any material with which to answer the questions which were raised regarding the effect and frequency of toothbrushing for the prevention of gingivitis and pyorrhea.

Kauffmann[14] says "A toothbrush is an artificial device used in conjunction with a dentifrice to brush the teeth . . . under the conditions in the mouth of the individual without causing injury to the hard tissues and adjacent soft tissues."

Rosendahl[24], claims that sepsis of the oral cavity resulting in tooth decay and pyorrhea may be prevented in many cases by the use of the proper method of brushing the teeth.

Blass and Roth [22, 23], indicate that one of the main causes of gum disease is improper or inadequate toothbrushing. They continue: "The toothbrush is the best means of stimulating blood circulation in the gums, increasing mouth resistance, and aiding the dentist in the elimination of gum diseases.

"It is essential to the normal functioning of every living cell that the flow of blood through it be ample and continuous."

They feel, as do most writers, that proper brushing will accomplish sufficient stimulation to keep the gingival tissues healthy, and thus prevent gingivitis and eventual pyorrhea in many cases. Blass [32] reiterates, "The toothbrush is the best means of stimulating blood circulation in the gums, increasing mouth resistance and aiding the dentist in elimination of gum disease."

Hirschfeld[25, 26], both in his text and articles claims that in patients subject to periodontal disease, the part of the periodontium most resistant to disease is that in which healthy circulation is maintained. He states, "The massage of the gums to improve blood circulation helps to maintain resistance to the establishment of gum diseases, such as gingivitis and pyorrhea."

As for the frequency of brushing the teeth, opinions vary from once to as many as five times per day. Smith[27], indicates that no matter how frequently the teeth may be cleaned during the day, they always should be cleaned thoroughly before bedtime, since bacteria increase rapidly in the mouth during sleep.

It is McGonagle's[28] opinion that "Before advising the patient in home care the mouth should be checked to find what he is doing. If it appears that he is getting good results suggest that he continue as in the past with limited suggestions."

Hirschfeld[25, 26], feels that for adequate care the patient must undertake to use the brush five times daily: On arising, after each meal, and on retiring. This routine, he feels, prevents food from adhering to the teeth long enough to form acids which cause irritation and inflammation of the gums. He concedes, if this procedure is impossible, that the teeth

should be brushed at least after breakfast and on retiring.

There are some, Charters[29], Rowlett[30], and McGonagle[28], who feel that brushing too long may be just as harmful as brushing too short a time or not at all.

One may summarize the present status of scientific information about the use of the centuries old toothbrush thusly:

1. To date, there have been few scientific researches published regarding the effects of toothbrushing on gingival tissues.

2. Most of the material in the literature is an expression of opinion by clinicians who fail to support their contentions with factual data.

3. The only phase of toothbrushing which has been covered so far in a scientific manner, is the design of the brush itself, and the testing of the material of which it is constructed.

4. Adequate research has been completed and is being completed on the formation of calculus. However, the explanation of the process is still in the theoretical stage.

5. There is nothing in the literature which indicates that stains can be eliminated by proper brushing, even though assertions have been made to that effect.

---

**BIBLIOGRAPHY**


1. Bibby, B. G. The formation of salivary calculus. Dent. Cosmos, 77:668-76, July 1935.
2. Box, H. F. Twelve periodontal studies. Toronto, The University of Toronto Press, 1940. 25 p. (p. 96-103).
3. Rapp, G. W. The biochemistry of oral calculus. Am. Dent. A. J., 32:1368-72, Nov.-Dec. 1945.
4. Kronfeld, Rudolf. Histopathology of the teeth and their surrounding structures. Philadelphia, Lee and Febiger, 1933. XII/479p. (p. 303).
5. Johnson, C. N., editorial. Why calculus? Am. Dent. A. J., 22:1540, Sept. 1935.
6. Yeretsky, Willa. Gingivitis: its cause and treatment. Am. Dent. A. J., 30:729-36, May 1, 1943.
7. Thoma, K. H. Oral pathology. 2nd ed., St. Louis, C. V. Mosby, 1944. XXI/1327 p. (p. 487).
8. McBride, W. C. Juvenile dentistry. 4th ed., Philadelphia, Lea and Febiger, 1945. 359 p. (p. 132).
9. Bunting, R. W., and Hill, T. J. A textbook of oral pathology. 2nd ed., Philadelphia, Lea and Febiger, 1940. 460 p. (p. 117-20).
10. Bunting, R. W. Oral hygiene and the treatment of periodontal diseases. Philadelphia, Lea and Febiger, 1936. 187 p. (p. 63).
11. Ayers, Polly. Green stain. Am. Dent. A. J., 26:3-12, Jan. 1939.
12. McCauley, H. B. Toothbrushes, tooth materials and design. Am. Dent. A. J., 33:283-92, Mar. 1, 1946.
13. MacFarlane, D. W. The stiffness of toothbrushes. Brit. Dent. J., 79:179-82, Oct. 5. 1945.
14. Kauffmann, J. H. A study of the toothbrush (I). Dent. Cosmos, 66:300-13, Mar. 1924.
15. ———. A study of the toothbrush (II). Dent. Cosmos, 71:132-40, Feb. 1929.
16. ———. A study of the toothbrush (III). Dent. Cosmos, 74:601-6, June 1932.
17. Kauffmann, J. H. A study of the toothbrush (LV). Am. Dent. A. J., 26:32-5, Jan. 1939.
18. ———. The child's toothbrush. J. Dent. Child., 8:231-3, 4th Quar. 1941.
19. Strusser, Harry. Simplified toothbrushing technique. J. Dent. Child., 8:208-9, 3rd Quar. 1941
20. Litten, A. S. Daily care of the mouth and teeth. N. Y. J. Dent., 12:240-1, June 1942.
21. Ceci, M. S. Oral prophylaxis. Wis. S. Dent. Soc J., 16:196-8, Nov.-Dec. 1940.
22. Blass, J. L., and Roth, Harry. Keep your own teeth. Dent. Outlook, 28:165-75, Apr. 1941.
23. ———. Keep your own teeth. Dent. Outlook, 28:124-32, Mar. 1941.
24. Rosendahl, P. O. The evolution of toothbrush manipulation, Minneapolis Dist. Dent. J., 25:95-8, Dec. 1941.
25. Hirschfeld, Isador. The toothbrush: its use and abuse. Brooklyn, Dental Items of Interest Publishing Company, 1939. XVI/591 p. (p. 43).
26. ———. The why and how of toothbrushing. Am. Dent. A. J., 32:80-5, Jan. 1, 1945.
27. Smith, F. S. Anatomic and physiologic conditions governing the use of the toothbrush. Am. Dent. A. J., 27:874-8, June 1940.
28. McGonagle, E. H. Home care of the teeth. Northwest Dent., 22:127-9, July 1943.
29. Charters, W. J. Prevention and elimination of the toothbrush and other stimulating instruments. Am. many causes of systemic disturbance by means of the Dent. A. J., 26:784-7, May 1939.
30. Rowlett, A. E. The toothbrush and how to use it. Brit. Dent. J., 75:92-4, Aug. 20, 1943.
31. Kauffmann, J. H. Use of the toothbrush. Dent. Cosmos, 73:196-7, Feb. 1931.
32. Blass, J. L. Dental home care of bleeding gums and pyorrhea. N. Y. 2nd Dist. Dental Soc. J., 28:208-12, Feb. 1942.
33. Frederick, B. N. The toothbrush, a "pleasure of God." Penn. Dent. J., 42:75, Jan. 1940.
34. Addis, Robert. The history of the toothbrush. Brit. Dent. J., 66:532-8, May 1939.
35. Yeretsky, Willa. A historical review of prophylaxis. J. Periodont., 10:81-7, July 1939.
36. Swendiman, G. A. The preservation and care of the interproximal gum tissue. Am. Dent. A. J., 31:175-83, Feb. 1, 1944.
37. Savage, W. H. Salivary calculus: its cause and control. Dent. Items Interest, 65:159-62, Feb. 1943.
38. Garvin, M. H. A practical analysis of regular dental prohylaxis. Am. Dent. A. J., 20:27-34, Jan. 1933.

# Give Us Tomorrow Our Rightful Dental Heritage

JAMES ROBINSON, Albany, N. Y.

*Editor's Note:*

*Mr. Robinson is better known as Jim to thousands of dentists, assistants and hygienists all over the country. He has appeared before more dental societies, civic and service clubs than any other man I know—and is continually being recalled for return engagements. As a believer in good dentistry and especially good dentistry for children, he is a staunch friend of our Society. Although his three children and charming wife see him not at all enough, they must be proud to have such an illustrious and popular head of the family, and I for one am proud to call him my friend, and welcome him to the pages of our Journal.*

*A.E.S.*

Dear friend Al:

Some time ago you asked me to write you some of my thoughts about dentistry for children. Well, here's my answer, based on my experiences and association with dentists and dental societies from coast to coast, for the past twenty years:

Despite all of the pleas by leading child practitioners, most dentists are unresponsive and show it by running away from child patients. Why do they do this? Well, for one thing, the dental colleges don't spend enough time teaching their students how to manage children and how dentistry for children may be done at a profit to both child and dentist. Sure, there are some colleges that do, but how many others like McBride, Sweet, Easlick, Seyler, Lamons, McFall, Ireland, and Teuscher are there? As all education should be conducted, we should turn to the embryo dentists and bring him out educated and inspired to concentrate on dental practice for children. We spend too much time with dentists who have established practices. Go to the young with everything that concerns the young and we will get much farther with dentistry for children. The average established dental practitioner simply is not interested in children and shows it to children and their parents alike. What child wants to go to a dentist who shows no interest or anxiety to serve?

It is too late to convert the vast majority of the older dentists to the admission of a greater number of child patients. Dentists in the middle or upper age brackets, conducting general practice, are interested in prosthetic work. They work for the careless and unfit. It is more profitable. They are pretty sure that there is no money in doing dentistry for children. Besides, they think children are hard to handle. People are always down on things they are not up on. They prefer to nurse the practices they now have and they feel quite sure that they will be very busy for the next several years because of the shortage of dentists. Unfortunately for children this philosophy works out. So, again I say, the hope of the future for dental health for children lies with the dental colleges and the younger dentists if you add public school teachers and dental hygienists.

SOME THINGS THE YOUNGER DENTISTS SHOULD BE TAUGHT.

First, that there is no such thing as children's dentistry. Dentistry for children is adult dentistry. Intellectual honesty dictates that only superlative dentistry belongs in the mouths of children. When we talk to students or young dentists, we must face the facts squarely. Tell them that their predecessors, on the whole, have done a wretched job for children. Tell them that you expect them to excel their fathers in dentistry by meeting

their obligations to children and learning to manage them properly.

Second, that the surest way to build a successful dental practice is through children. Adults wish to be handled like children in a dental chair. A dental practice founded without children always breaks down within twenty years.

Third, the great sense of achievement and satisfaction that comes with working successfully for children. What a wonderful feeling it is to have a little child thank you for something; what a great joy to know that you have released an imprisoned personality; the sweet comfort in the knowledge that you have contributed to the welfare of society for the future; the glow that comes with knowing that you have made a little child more acceptable even to her playmates; the eternal hope you come to feel inside of you that a child's mouth, restored to health and beauty, will insure her speech, defend her ability to hear and bring sunshine to her smile. These and countless other things are the gifts that come to you when you practice for children. Physicians work, most of the time, for the helpless. Dentists work for the workers and the young dentist for the future.

Fourth, that the diagnostic program compels the influence of parents to embrace orthodontics in behalf of the child when indicated. It is a solemn duty to educate parents and children even when the work must be referred to others.

Some one should come forward and send a copy of the Journal of the A.S.D.C. to every dental student in the world—freshmen included. When a wonderful acticle comes along like "Give Your Child Half A Hog's Chance," as appeared in the LADIES' HOME JOURNAL, it should be seized by the A.D.A. and distributed to every school teacher and every dentist and dental hygienist in the world.

I have a great anxiety to say something about the American Society of Dentistry for Children and its Journal. No special group in this country has more talent and greater earnestness in its desire to help children through dentistry and to inspire the aid of others. Its officers and editorial staff are composed of men and women who give their time and talent in unselfish devotion to a cause more worthy than any other branch of dentistry. It is my profound belief that there will be a special place in heaven for all those who devote themselves to the betterment of the lives of children. Some of the members have no children of their own. I have the matchless blessing of three small children and I should like to think that my children's children would find dentistry equipped, ready and anxious to serve them through education and manual corrective measures if necessary. That will be ten or fifteen years from now. If the dentists who can't or won't work for children at the chair will do their share in supporting the program of this Society; if the dental colleges will give more time and more complete courses on dentistry for children; if lay educational material will be provided for every schoolroom; if dental hygienists are placed in every school, then and only then will my grandchildren and yours be given their rightful heritage in a country that gave dentistry to the world.

Sincerely yours,

Jim Robinson.

# The Physical and Chemical Properties of Silver Amalgam

RAY A. JACOBSON, D.D.S.

Despite the many restorative failures and general criticisms of silver amalgam, the record proves that it is still the material most universally used by the dentist. Perhaps it is this indiscriminate use of silver amalgam which leads to its mistreatment.

## Review of Literature

In 1826 silver pastes were first advocated in Paris, and brought to the United States in 1833. These materials were very crude, and caused what was known as the amalgam war. This was due to two reasons; first the material was introduced by two Frenchmen; second the use of this paste was opposed on the assumption that it caused mercurial poisoning. In 1855 Elisha Townsend gave to dentistry the first formula for an alloy mixed with mercury.[3] Although these silver pastes did not have any refinements, they were the beginning of the silver alloys in use today.

The American Dental Association Specifications in 1934[7] had the following general and detail requirements:

General requirements:

1. Thorough amalgamation in three minutes.
2. Absence of granular or sandy consistency when amalgamated.
3. Susceptibility to carving for at least fifteen minutes after amalgamation.
4. Susceptibility to receiving and retaining a polish twenty-four hours after amalgamation.

Detail requirements:

1. Chemical composition shall be within the following limits[8]
   Silver—65 per cent minimum
   Copper—6 per cent minimum
   Zinc—2 per cent maximum
   Tin—25 per cent maximum

It is quite apparent that silver and tin are essential constituents of the alloy. If the silver content of the alloy is lower than the minimum 65 per cent, alloys invariably shrink and exhibit low strength and high flow values.[9] Tin according to Gaylor[10], is the composition factor which determines whether or not an amalgam is suitable for use as a filling material. As far as physical properties go, tin is the most harmful, but its advantage is the strong affinity for mercury, and its ability to decrease the amalgamation time in combination with silver. Tin reduces expansion under ordinary methods of manipulation.[11]

Copper is used to replace silver in small amounts only, and must be used sparingly, as it increases expansion of amalgam in setting. The purpose of the element zinc in an alloy is not exactly known. Black[12] found when zinc was present in an alloy of silver 61.75 percent, tin 33.25 per cent, and zinc 5 per cent, that it decreased the flow and increased both crushing strength and expansion.

Dimensional Change—The finished amalgam has one physical property not covered by composition of the alloy. This property is dimensional change, and is the leading cause of amalgam failure. According to investigators[14] up to the present time, dimensional changes are controlled by the following:

a. Flow can be kept to a minimum by eliminating as much mercury as possible.
b. Excessive expansion is reduced by keeping the whole operation free of contamination.
c. Shrinkage is caused by excessive amounts of tin, finely cut particles, and excessive grinding in mixing and excessive packing pressures.

According to Jarabeck,[17] the expansion of amalgam restorations decreases as the particles become smaller. Decreases in particle size causes a diminishing of the effect of trituration on dimensional change in practically all alloys. In most instances, a greater sensitivity to dimensional change exists in the coarser particle sizes for a given trituration and condensation. As the particles become smaller, the effect of condensation on dimensional change become less apparent. Particles that will pass through a number 325 mesh are preferred.

Gray[18] produced evidence of the fact that age affects contraction and expansion. The expansion decreases as the filings are aged, and shrinkage is greater as the filings become aged. In the case of the older filings, less mercury is required for mixing and a slower setting time results. Amalgam fillings expand from 3 to 13 microns during the first 24 hours. The maximum was raised to 13 microns in the last specification.[19] Worner[20] has shown that the amount of flow decreases as the silver content of the amalgam increases. According to the National Bureau of Standards, flow will be at a minimum when the amalgam is handled according to instructions. The critical period being from 2 to 5 hours,

immediately after packing.

Factors of Physical Properties in Relation to Manipulation.—Nine unsafe practices with direct bearing on the properties of the amalgam restoration as noted by Ray[21] are:

1. Selection and use of low grade alloys.
2. Over trituration.
3. Using heavy grinding pressures.
4. Working the alloy after the initial trituration.
5. Adding mercury after the mix is made.
6. Using excessive packing pressures.
7. Permitting saliva to come in contact with the alloy during packing.
8. Condensing insufficiently.
9. Failing to finish the surface margins.

In order to get a uniform mix seven procedures should be followed[22];

1. Mortar should be roughened with No. 2 fine carborundum abrasive, once every two weeks in the average practice.
2. Mixing pressure of 2 to 4 pounds with a pen grip on pestle, and mixing speed of 220 R.P.M.
3. Hold mortar on table top and rotate while mixing.
4. Determine the proper mercury-alloy ratio.
5. If mixing in mortar, do not mix until amalgam sticks to side of mortar.
6. Do not remove mercury before condensing.
7. Use maximum allowable packing pressure, 6 to 10 pounds.

Mechanical amalgamators and condensers do have merit, but they also have the bad features of possible over-trituration and over-condensation which affects dimensional change of the filling. If directions are closely followed, in the hands of some operators mechanical amalgamators and condensers may prove to be of advantage and a time saver. Many articles have been written about these advantages. Phillips[24] says that mechanical amalgamation eliminates human variables, and that with the mechanical condenser expansion is reduced and crushing strength is increased.

A proper ratio between the alloy and mercury is one that will permit, with a normal amount of mixing, the production of a mass of alloy and mercury that is suitable for packing. That ratio of alloy and mercury should be 5 to 8 for packing, and in the finished filling 5 to 5. Any technic which leaves more mercury in the filling than this ratio will prolong the expansion period[25].

In the final condensing of the filling, burnishing of the amalgam toward the margins of the cavity results in margins of low quality[26]. The work of Bull[27], by re-enforcement with pieces of 90% silver plate, was a contribution toward the problem of greater marginal strength and less flow of amalgam restorations.

A great deal of thought should be given to the question of pressure in packing the alloy. There are two extremes; one of no pressure at all, the other excessive pressure. The middle of these two is correct[28]. Over-condensation will cause a flaking of the amalgam.

One advantage in the use of dental amalgam is the ease with which it can be prepared, condensed into irregular cavities, and carved during the plastic stage to exact dental anatomy. This advantage can, however, be offset by dimensional change. These changes are flow, shrinkage, and excessive expansion. Flow is kept at a minimum by elimination of as much mercury as possible, use of small amounts and correct packing pressure. The dentist should avoid small contact areas, thin edges, and heavy occlusal stresses. Shrinkage is caused by an excess of tin, too finely cut particles, over-trituration and excessive packing pressures. Usually excessive expansion is the result of contamination. To avoid this the dentist's problem is one of cleanliness through out all operative procedures.

Trituration must be systematic; roughening of the mortar and pestle with No. 2 fine carborundum powder occasionally, and during amalgamation the mortar should be inclined, rotated, or jarred so that every particle is incorporated.

The final properties of any filling are determined by the dentist who inserts it in the cavity. Trial and error approaches have long since been found inadequate for making consistently good amalgam restorations.